

UNITED STATES PATENT APPLICATION

*of*

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*for*

MULTI-INTERFACE TELEPHONY TEST SYSTEM USING SEPARATE  
INTERFACE CARDS

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## TITLE OF THE INVENTION

Multi-Interface Telephony Test System Using Separate Interface Cards

## CROSS REFERENCE TO RELATED APPLICATIONS

5           This application claims priority under 35 U.S.C. §119(e) to provisional patent application serial number 60/241,537 filed October 18, 2000; the disclosure of which is incorporated herein by reference.

## BACKGROUND OF THE INVENTION

10           T1 and E1 are interfaces for telecommunications channels. T1 comprises the North American format for digital transmission of data. T1 supports data rates of 1.554 Mbits per second. A T1 line comprises 24 individual channels, each supporting 64Kbits per second. Each channel of a T1 line can be configured to carry either voice or data traffic.

15           E1 is similar to T1, except that E1 is the European format for digital transmission. E1 supports data rates at 2.048 Mbits per second. An E1 line comprises 32 channels at 64K bits per second each. Similar to T1, E1 can be configured to carry either voice or data traffic.

20           Prior to the present invention there has not been a telecommunication test system capable of running both T1 and E1 interfaces with a single set of voice channel resource cards. There are T1/E1 switchable test systems, however these systems included cards which had switchable framers and separate DSP resource  
25           cards. Previously, it was necessary to utilize a full set of T1 resource cards for testing T1 interfaces and a full set of E1 resource cards for testing E1 interfaces, all in a single system. One of the reasons for this is that T1 and E1 have different

electrical interfaces so providing a solution would require a hardware based enhancement as the capability is not software programmable.

Alternatives to the present invention include duplicating the voice resources on both T1 and E1 Physical interface boards. This would result in using twice the number of boards or twice the number of systems to get the same number of channels. This method would prove to be costly to implement. Another alternative would involve modifying the system to use the physical interfaces without allocating full voice channel DSP resources. This method would provide a less flexible and capable test system. A further alternative would be to design a new board with a programmable part to accomplish the T1/E1 interface swapping. This method would be proprietary, slow, and expensive. Yet another alternative would be to physically swap boards in and out of the test system when needed. This method would also be expensive as well as prone to error, and would require manual labor by the customer. Still another alternative involves utilizing an external switch simulator that can convert T1 to E1 and vice versa. This method is expensive and impractical. In view of the above, it would be desirable to provide a multi-interface telephony test system using separate interface cards.

#### SUMMARY OF THE INVENTION

With the foregoing background in mind, it is an object of the present invention to configure the hardware and software resources in a system to utilize two physical interface boards in pairs such that their aggregate units of voice processing DSP resources can be applied to either all of a T1 board's physical interfaces or all of an E1 board's physical interfaces. This allows a single

telecommunications system to run as either T1 or E1 with no additional hardware required.

5 The present invention also requires the ability to run protocols normally associated with T1 physical interfaces on a card with only E1 physical interfaces. It was further required that a method for changing the configuration from T1 to E1 and from E1 to T1 be provided as well. Additionally, a method for configuring the system to look like a single set of contiguous T1 or E1 channels was developed, when in fact the hardware resources are not contiguous.

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It was also desirable to provide a method for monitoring audio by switching the Pulse Code Modulated (PCM) audio streams from/to an audio enabled resource board and switching between listening to Mu-law encoded audio for T1 and A-law encoded audio for E1. The present invention also permits the system to be cabled as T1 and E1 at the same time.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood by reference to the following more detailed description and accompanying drawings in which:

20 Fig. 1 is a block diagram showing the switching configuration of an interface board and a resource board according to the present invention; and

Fig. 2 is a diagram of a rear view of a chassis containing both E1 and T1 modules.

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## DETAILED DESCRIPTION

In a particular embodiment, the resource card in the telecommunication test system has four physical and electrical interfaces for T1 or E1 (for a total of 96 voice channels or 120 voice channels). However, the resource card has only  
5 enough voice resources to run two physical interfaces (for a total of 48 or 60 simultaneous voice channels). Accordingly, two of the physical interfaces are disabled and left idle.

In order to provide a multi-interface telephony test system it was  
10 necessary to perform several modifications to an existing system. In particular, the DSP resources from one card had to be shared with another card.

Referring now to Fig. 1, a diagram showing the configuration necessary to accomplish part of the present invention is shown. A first interface board, such  
15 as a T1 interface board is shown. The interface board includes an h.100 switch block 100, a local switch block 110, an HDLC 120, a Digital Signal Processor (DSP) 130 and four Framers 140, 150, 160 and 170. The data from Framer 140 (span 0) is fed into local switch block 110. The data leaves local switch block 110 and is provided to DSP 130. The output of DSP 130 is connected to another  
20 port of local switch block 110, which provides the signal back to Framer 140.

Framer 150 is similar to Framer 140 and signals from Framer 150 follow a similar path. The signal leaves Framer 150 and is received by local switch block 110. The signal exits local switch block 110 and is directed to DSP 130. From  
25 DSP 130 the signal travels back to local switch block 110 and from there back to Framer 140.

While prior to the presently disclosed invention framer 160 and 170 would be left idle, now they can be used. The signal exiting framer 160 goes to local switch block 110 and from there to H.100 switch block 100.

5           Beginning with the lines coming from the Framer span 2 160 and Framer span 3 170 of the Interface board 10, these lines are routed to the H.100 bus 30 through programmable switches labeled local switch block 110 and H.100 switch block 100. From the h.100 bus 30, at the Resource board 20, the lines are routed through programmable switches H.100 switch block 200 and local switch block  
10   210 to DSP (60) 230 of the Resource board 20. From DSP (60) 230 of the Resource board 20, the lines are routed back through local switch block 210 and h.100 switch block 200 to the H.100 bus 30. From the H.100 bus 30, the lines are routed through the H.100 switch block 100 and the local switch block 110 of the interface board 10 and back to the Framer span 2 160 and Framer span 3 170.  
15   Accordingly, the DSP (60) 230 of the Resource board 20 is utilized by the interfaces 160 and 170 of the Interface board 10, thereby allowing for all four of the physical interfaces of the interface board to be utilized.

20           The present invention also required the ability to run protocols normally associated with T1 physical interfaces on a card with only E1 physical interfaces. Referring to Fig 1, the physical interfaces (Framers 240, 250, 260, and 270) are independent of the DSP resources (DSP 230) used to implement the protocol on the interfaces; this invention took advantage of this fact and ran T1 protocols on DSP 230. It was further required that a method for changing the configuration  
25   from T1 to E1 and from E1 to T1 be provided. Logically this is done by switching the roles of the Interface Board (10) and the Resource Board (20) in Figure 1. The software that initializes this application reads in the current switch configuration

from a data file. This data file tells the software to either treat the system as a T1 system where the T1 interfaces will be used along with sharing the DSP from the E1 boards or to treat the system as a E1 system where the E1 interfaces will be used along with sharing the DSP from the T1 board. A simple GUI application was created for the user to choose which configuration file to use. Additionally, a method for configuring the system to look like a single set of contiguous T1 or E1 channels was developed, when in fact the hardware resources were not contiguous. This was done in software by presenting to the user a single set of either T1 or E1 test ports. This is important so the user of the system does not have to worry weather a given test port is active or not. Only active test ports are shown.

It was also desirable to provide a method for monitoring audio by switching the Pulse Code Modulate (PCM) audio streams from/to an audio enabled resource board and switching between listening to Mu-law encoded audio and A-law encoded audio (because T1 audio is usually Mu-law encoded and E1 audio is usually a-law encoded). The audio enabled resource board is able to receive either a-law encoded streams or Mu-law encodes streams but not both at once. Software was written to dynamically switch the audio board from Mu-law to a-law and vice versa. The software configures the audio board to be enabled for the correct encoding when the user switches from one configuration to the other.

The present invention also permits the system to be cabled as T1 and E1 at the same time. While the use of E1 or T1 interfaces was described the present invention could also be used with other interfaces including, but not limited to, T3 and E3.

Having described preferred embodiments of the invention it will now become apparent to those of ordinary skill in the art that other embodiments incorporating these concepts may be used. Additionally, the software included as part of the invention may be embodied in a computer program product that  
5 includes a computer useable medium. For example, such a computer usable medium can include a readable memory device, such as a hard drive device, a CD-ROM, a DVD-ROM, or a computer diskette, having computer readable program code segments stored thereon. The computer readable medium can also include a communications link, either optical, wired, or wireless, having program  
10 code segments carried thereon as digital or analog signals. Accordingly, it is submitted that that the invention should not be limited to the described embodiments but rather should be limited only by the spirit and scope of the appended claims.